

Draft Recovery Plan for the San Benito Evening-primrose

(Camissonia benitensis)

SAN BENITO EVENING-PRIMROSE RECOVERY PLAN (DRAFT)

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LITERATURE CITATION

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EXECUTIVE SUMMARY OF THE
RECOVERY PLAN FOR THE SAN BENITO EVENING-PRIMROSE
(*Camissonia benitensis*)

Current Species Status: Threatened. As of 1998, San Benito evening-primrose is known from 27 occurrences and 52 suboccurrences (mapped sites) that include four small artificial suboccurrences. About two-thirds of the occurrences have been adversely affected by off-road vehicles.

Habitat Requirements and Limiting Factors: The San Benito evening-primrose is naturally limited to serpentine-derived alluvial terraces and deposits near San Benito Mountain, southern San Benito County, and western Fresno County, California. The principal threat to the San Benito evening-primrose is erosion resulting from the use of off-highway vehicles (OHVs) for recreation.

Recovery Priority: 5C (reflecting a high degree of threat, low recovery potential, species [rather than subspecies or genus consisting of a single species], in conflict with construction or development projects).

Recovery Objective: Delist. Interim objective is to protect and restore existing populations and potential habitat.

Recovery Criteria: The minimum criterion for delisting is the protection of at least 15 large ($\pm 10,000$ plants each) and 30 small (± 500 plants each) self-sustaining populations from the threats of Off Highway Vehicle (OHV) recreation and resultant erosion.

Date to recovery: 2009 at the earliest. It is more likely that recovery will require decades (see page 20)

Actions Needed:

1. Prevent additional degradation and loss of San Benito evening-primrose habitat.
2. Develop and implement an OHV management plan, to provide for the recovery of the San Benito evening-primrose on areas managed by the Bureau of Land Management (Bureau).
3. Protect populations on non-Bureau lands.
4. Protect populations from other activities.
5. Develop public awareness program.

Total Estimated Cost of Recovery: \$864,000. Costs, in thousands of dollars:

<u>Year</u>	<u>Action 1</u>	<u>Action 2</u>	<u>Action 3</u>	<u>Action 4</u>	<u>Action 5</u>	<u>total</u>
1997	173	29	4	1	17	226
1998	145	29	4	1	12	190
1999	22	29	3	1	12	166
2000	97	29	3	1	12	141
2001	97	29	3	1	12	141
Total	634	145	17	5	48	864

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I. INTRODUCTION

A. BRIEF OVERVIEW

The San Benito evening-primrose (*Camissonia benitensis* Raven) is a small, yellow-flowered, annual herb. It is restricted (*endemic*) to serpentine alluvial deposits in San Benito and Fresno Counties, California. Of the 27 known occurrences, 20 are entirely and 2 are partially on lands administered by the U.S. Bureau of Land Management (Bureau). One private occurrence (261100) is protected by being completely fenced. Off-Highway-Vehicle (OHV) recreation has been identified as the principal threat to the species and the local ecosystem since as early as 1970 (U.S. Bureau of Land Management 1970). The U.S. Fish and Wildlife Service (Service) proposed to list the San Benito evening-primrose as an endangered species on October 31, 1983 (48 Federal Register 50126) based on the threat from motorized recreation. Additional threats included road construction and maintenance, other recreational activities (camping, gem hunting, prospecting), gravel mining, prospecting with bulldozers, vandalism, and randomly occurring events (*environmental stochasticity*), due to the small number of individuals in each population. In recognition of protective measures proposed by the Bureau, the Service on February 12, 1985 (50 Federal Register 5755) designated the San Benito evening-primrose as a threatened, rather than endangered, species.

Some protective measures were less effective than intended until 1996, partly because fenced areas with the San Benito evening-primrose were close to camping areas and OHV recreation and trails (Taylor 1995). In 1996, the Bureau, by shifting its management focus from occupied habitat to potential habitat (U.S. Bureau of Land Management 1997a) and expanding erosion control efforts to the watershed scale (Pacific Watershed Associates 1995), began reducing the threats to the San Benito evening-primrose. Key protective measures developed during 1996-1997 Bureau consultation with the Service include ongoing systematic inventory and user compliance monitoring programs. Enforcement measures were identified that would be triggered if non-compliance by users increased (Service 1997).

B. DESCRIPTION

The San Benito evening-primrose was first described by Peter Raven (1969). It is an annual lacking a cluster of leaves at ground level (a basal rosette), but occasionally has clusters of several linear, villous (covered with soft, fine, unmatted hairs) leaves near the base of its wiry stem, which occasionally attains a height of 25 centimeters (10 inches). The purplish-green herb produces many secondary branches at right angles to the main stem. The branches with flowers (the *inflorescence*) are covered with glandular-pubescent and villous hairs. The flowers are nodding when they are open and, like most *Camissonia*, the flowers open near sunrise. (Flowers open at dusk in the closely-related evening-primrose genus *Oenothera*, thus their common name). Although the flowers are bright yellow with occasional red dots at the base of each petal, the species can be cryptic during inclement weather when its flowers frequently remain closed. Excellent descriptions and instructions on how to distinguish the area's *Camissonia* and *Oenothera* species are available in a Bureau-contracted report on the ecology and life history of the San Benito evening-primrose (Taylor 1990).

C. DISTRIBUTION

Taylor (1990) continued and improved a long-standing naming convention of *Camissonia benitensis* sites/populations. In 1996 the Bureau conducted a baseline inventory that sought to incorporate potential habitat with occupied habitat (U.S. Bureau of Land Management 1997a). As a result of that effort the benefits of the California Natural Diversity Database's use of the term "occurrence" became apparent. An "occurrence" is defined in Bureau reports from 1996 onward and in this recovery plan as any plant within 0.25 mile (shortest distance) of any other. This definition resulted in some lumping of plant groups that had been previously monitored as separate populations, including some introduced populations. For consistency, these plant groups are recognized as "suboccurrences" and continue to be monitored separately. A suboccurrence was defined as any group of plants that differed notably in habitat characteristics (slope, aspect, disturbance regime) or geographic location from any other group of plants belonging to the same occurrence (U.S. Bureau of Land Management 1997a). This recovery plan conforms to the

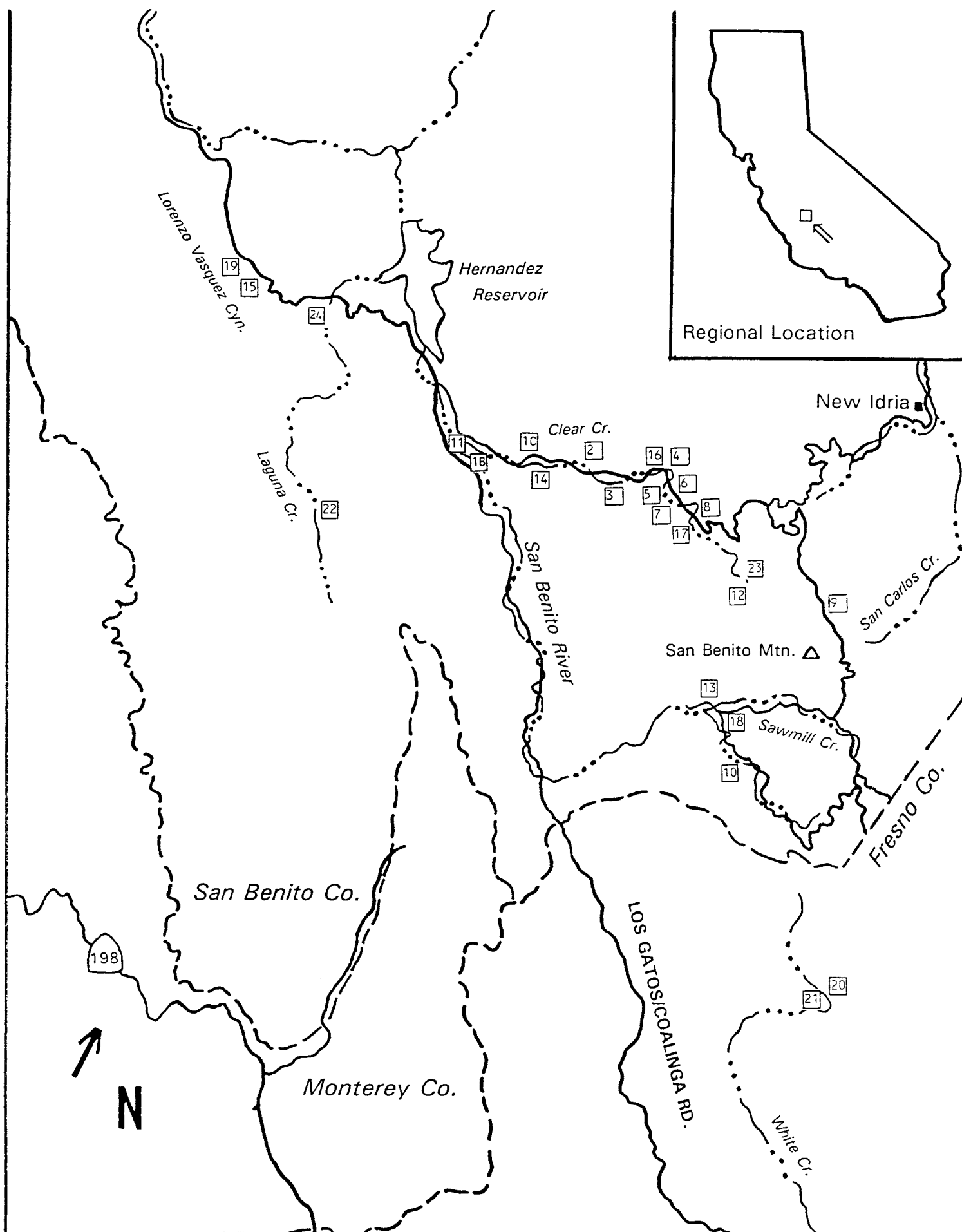


Figure 1. DISTRIBUTION OF *Camissonia benitensis* POPULATIONS

Bureau's current practice of identifying sites as occurrences and suboccurrences, while restricting the use of "population" to discussions of population trends, i.e., number of individuals over time for the entire species or defined subunits. Another term that comes from the Bureau's inventory and compliance monitoring programs for San Benito evening-primrose is "potential habitat polygon." This is a mapped area (as in a geographic information system) whose boundaries enclose moderate-to-high quality habitat. A potential habitat polygon generally includes at least one occurrence, but it may also demarcate unoccupied habitat. "Site" is used nontechnically to refer to localities, with or without occurrences.

The San Benito evening-primrose is known from 23 natural occurrences and 4 artificially-seeded ones (Figure 1), with 1 occurrence along White Creek; 3 suboccurrences (2 private, 1 Bureau) in western Fresno County and 22 occurrences (3 private, 19 Bureau) in southeastern San Benito County . The San Benito County occurrences are distributed over an area about 20 miles long by 5 miles wide, with most of the occurrences (14) and individuals along a 5-mile segment of lower Clear Creek. Other occurrences are on San Carlos Creek (1), San Benito River (2), Laguna Creek (2), Lorenzo Vasquez Canyon (2). The type locality¹ has been believed to be occurrence 51000 (formerly population 5) along Clear Creek, but a recent review of historic route alignments casts considerable doubt on that assertion (Sam Fitton, Wildlife Biologist, Bureau of Land Management, Hollister Field Office, pers. obs., 1998). Details of the species' distribution, population, habitat, status and voucher history are found in Taylor's initial report and subsequent progress reports to the Bureau (Taylor 1990, 1991, 1993, and 1995) and annual reports prepared by the Bureau (U.S. Bureau of Land Management 1993, 1994, 1997a, 1997b, and 1998).

	total	Bureau	Clear Creek	Percent of Clear Creek managed by Bureau	Clear Ck. percent of total	Partial Bureau	Private
occurrence	27	20	14	70	52	2	5*
suboccurrence	52	45	29	64	56	2	5

* one private occurrence is entirely protected by a fence (261100).

¹ A botanical name is tied to *type specimen(s)*, collected from a single site, the *type locality*. This is often the first site where a species was collected.

D. POPULATION STATUS

Taylor's (1995) inventory of the region from 1987 to 1994 essentially doubled the known number of occurrences of the San Benito evening-primrose. Inventories in 1996 added 2 new occurrences with 7 new suboccurrences (U.S. Bureau of Land Management 1997a). As many as four new occurrences with 16 new suboccurrences were found during the 1998 inventory, pending identification of specimens (U.S. Bureau of Land Management 1998). The number of individuals in occurrences/suboccurrences has varied dramatically from year to year (Table 1). Occurrence 51100 (population 6) offers a striking example of fluctuations, from 6,000 plants in 1988 to none in 1989 (Taylor 1993). Precipitation varied from 40 to 225 percent of the regional normal amount during the ten-year monitoring period, and good growing years appear to coincide with years of intermediate rainfall (80-150 percent) (Taylor 1995). Before Taylor's work, monitoring of occurrence sizes consisted of placing occurrences in estimated size classes, a technique used by the Natural Diversity Data Base of the Natural Heritage Division of the California Department of Fish and Game. Taylor established quadrats along a line intercept transect and extrapolated plant densities based on the area covered for two of the larger occurrences. Since Taylor's work a combination of direct counts and estimation has been used (U.S. Bureau of Land Management 1997a).

A few studies have attempted to estimate the viable population size, defined as the number of plants needed to avoid extinction with a 95 percent probability of persistence for 100 years (Shaffer 1987, Menges 1991). A population size of 1,000 may be adequate for a long-lived perennial species, while annual species require larger populations (at least 1 million) to survive natural perturbation events that can eliminate occurrences and suitable habitat. In comparison, only five *Camissonia benitensis* occurrences have had more than 1,000 individuals in any single year (1988); in some years no occurrences reached even this low number (1983, 1984, 1987, 1990, 1994, 1997). Whether this is cause for concern is difficult to say, because for an annual species, estimates of occurrence sizes should include viable seeds in the soil. So far, annual counts and estimates have not included this stage of the species' life cycle. Seed banks in the soil are potentially very important for San Benito evening-primrose.

TABLE 1. San Benito evening-primrose population trends

site #	1979	1980	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1													5	4
1B								18691	921	84	85	400	419	100
1C						25	0	0	0	0	0	147	15	0
2			75	4	85	100	0	1540	0	0	180	354	1158	0
3			30	1	65	75	0	672	0	0	2	29	4	0
4		250	30	2	158	25	2	357	27	0	0	82	303	27
5			550	10	10000	2500	112	133507	357	44	4450	28000	575	133
6			30	21	1900	100	1	5976	0	0	422	163	200	12
7			5	0	0	0	0	0	0	0	0	28	15	0
8			50	0	10	15	0	27	0	0	0	40	11	38
9	25		550	30	1400	750	149	4398	247	12	0	1355	318	50
10									102	0	0	475	212	20
11									16	1	40	128	125	0
12									3	0	0	8	0	0
13									21	0	0	12	0	0
14									9	5	7	96	29	0
15											21	149	0	0
16												16	5	21
17												3	0	0
18												101	0	0
19												400	1459	281
20												88	112	1
21												9	54	0
22												125	0	0
23													65	16
24														175
Totals	25	1320	68	13618	3590	264	165168	1703	1703	146	5207	32208	5084	878

This table uses the old method of site numbering. Populations 1C, 7, 16, and 17 are introduction attempts.

Table 2. San Benito evening-primrose: Population counts in the Clear Creek watershed as a percentage of total population counts, by year.

Year	Clear Creek watershed populations	Total populations	Clear Creek as a percent of total
1998	7564	13125	57.6
1997	819	1718	47.6
1996	13232	17000	77.8
1995	0	0	0
1994	461	863	53.4
1993	4087	6568	62.2
1992	29848	33917	88.0
1991	5366	5387	99.6
1990	134	158	84.8
1989	1333	1950	68.3
1988	162310	171106	94.8
1987	115	413	27.8
1986	2940	4440	66.2
1985	12303	15103	81.4
1984	42	102	41.4
1983	845	1945	43.4
1980	250	250	100.0
1979	50	50	100.0

E. HABITAT/ECOSYSTEM

San Benito evening-primrose is restricted to sites whose soils are derived from serpentine rock, which is rare on the continents. Its chemical composition (called *ultrabasic* or *ultramafic* by geologists) makes it toxic to most plants. These hostile soils tend to be occupied by specialist plants (including *serpentine endemic* species that occur only on serpentine).

Serpentine soils and vegetation have been extensively studied since the early 1940's. Serpentine soils, although generally rich in magnesium, iron, and silica, contain low levels of calcium. Moreover, these soils typically harbor heavy metals (e.g., chromium and nickel) and have concentrations of molybdenum, nitrogen, phosphorus, and potassium inadequate for normal plant growth (Kruckeberg 1984). The soils are iron-rich, with montmorillonite clay. They are heavy, retain moisture, and are highly erodible (Kruckeberg 1984). Water moving between silica layers of the clay minerals causes considerable expansion, creating a crust on the soil surface, which normally protects serpentine soils from erosion.

The serpentine alluvial flats, terraces, and debris flows (alluvial outwash) in San Benito and Fresno counties adjoining San Benito, White, Laguna, Larios, Clear, and San Carlos Creeks, as well as an unnamed tributary to the San Benito River downstream of its confluence with Lorenzo Vasquez Creek, and Lorenzo Vasquez Canyon are the only known habitats for the San Benito evening-primrose. Debris flows in the area have not been thoroughly surveyed. The substrate for most of the plant's distribution is the largest serpentine formation in the southern Coast Ranges (Jennings 1977), the San Benito serpentine body. It ranges in elevation from 2,650 to 5,241 feet (800 to 1,600 meters) and "extends around San Benito Mountain as a 4 by 13 mile (6.5 by 21 kilometer) oval along the main Diablo Range divide in San Benito and Fresno Counties" (Griffin 1984). Most of the San Benito serpentine body, covering about 30,000 acres is on public land administered by the Bureau within its 50,350 acre (20,390 hectare) Clear Creek Management Area (CCMA). Access to the area is provided by Clear Creek Road, which crosses the creek bed several times, and Spanish Lake Road, which essentially follows the ridge. West of the San Benito Mountain area at Laguna Mountain and Hepsedam Peak, smaller serpentine bodies and related erosional land surfaces support small disjunct (geographically separated) occurrences of the San Benito evening-primrose and other serpentine endemics on private and Bureau lands. Soils developed from the San Benito serpentine body contain high levels of free asbestos fibers, which pose human safety hazards.

Serpentine soils, including those of the Clear Creek area, essentially are toxic to much of California's flora, preventing many annual herbs, notably introduced annual grasses, from growing successfully. Ten percent of the narrowly-distributed (*endemic*) plants of California are restricted to serpentine, a habitat type occurring on less than 1 percent of the state's land mass. Serpentine-tolerating plants confined to ultrabasic substrates, like the San Benito evening-primrose, are referred to by Kruckeberg (1984) as "Group III" plants. Such species are generally herbaceous, narrow endemics, which can persist on these unique soils where the more competitive plants of non-serpentine soils are absent. Although Group III plants can be grown on non-serpentine soil, they cannot compete with the more-aggressive, serpentine-shunning species. The serpentine soils that have developed on stream terraces are notably richer in organic material than the barren serpentine slopes that are the region's unique feature. The terrace soils are well drained, gravelly-to-sandy, moderately deep, and apparently take long periods of time to develop (Taylor 1990).

The flat-to-gently sloping, gravel-covered, alluvial serpentine terraces and debris flows to which the San Benito evening-primrose is restricted are not without other plant life. In suitable areas with intact soils two serpentine endemics, Coville's buckwheat (*Eriogonum covilleianum*) and Brewer's jewelflower (*Streptanthus brewerii*), can be found in low densities during years of high rainfall. In the Clear Creek area in general, though usually not on the terraces, serpentine chaparral is the dominant vegetation, with scattered barrens throughout. Shrubs like chamise (*Adenostoma fasciculatum*), buckbrush (*Ceanothus cuneatus*), leather oak (*Quercus durata*), bigberry manzanita (*Arctostaphylos glauca*), and Mexican manzanita (*A. pungens*) grow with the San Benito evening-primrose on the alluvial terraces and more abundantly on the surrounding slopes. Scattered within the chaparral are several conifers: incense cedar (*Calocedrus decurrens*), Coulter pine (*Pinus coulteri*), Jeffrey pine (*P. jeffreyi*), and foothill pine (*P. sabiniana*). Jeffrey pine makes its only appearance in the south Coast ranges on the serpentine barrens of San Benito Mountain (Kruckeberg 1984).

Taylor (1990) reports that woody vegetation is encroaching into barren areas on the alluvial terraces and may be reducing the amount of habitat available for the San Benito evening-primrose. This observation may be confirmed by the more precisely established photo-points started in 1996 (U.S. Bureau of Land Management 1997a).

In the Clear Creek area, 53 terraces (the majority of the potential habitat for the evening-primrose given the current understanding of its requirements) were inventoried for habitat suitability for this plant (Taylor 1990). Nine terraces were occupied by the San Benito evening-primrose and six appeared suitable but unoccupied. Suitable habitat consists

of alluvial terraces or areas adjacent to slopes (alluvial outwash) below an elevation of about 4,500 feet. The habitat is flat to gently sloping (less than 3 degrees), on residual serpentine or serpentine alluvium that is subject to frost heaving, with minimal cover of surface gravel, and with an association of annual plants (Taylor 1990). Terraces covered with brush lacked San Benito evening-primrose, while removal of brush from terraces with intact soils offers high potential for creating suitable habitat (Taylor 1990). Recently the San Benito evening-primrose has been observed growing within trail and road treads (3 occurrences), on compacted soils of campgrounds (4 occurrences), and on year-old sediment deposits (two occurrences) (U.S. Bureau of Land Management 1997a, 1998). While this is not the norm, it gives an indication that the substrate requirements may be less restrictive than originally thought and tolerance to impacts higher.

Occurrences of the San Benito evening-primrose are associated with a sparse cover of woody vegetation and herbaceous vegetation (Taylor 1990) and a large proportion of bare ground, compared with other native herbaceous vegetation. Phytosocial² analysis of the habitat of San Benito evening-primrose identified six annual herbs that can be used as indicators for suitable habitat: *Cryptantha micrantha* (popcorn flower), *Erodium cicutarium* (filaree), *Eschscholzia californica* (California poppy), *Malacothrix floccifera* (wooly malacothrix), *Lotus subpinnatus* (deerweed), and *Vulpia microstachys* (Nuttall's fescue). The only non-native species is *Erodium cicutarium* (Taylor 1990). High quality (pristine) sites have a rich species diversity of native annual herbs (35-45 species).

The Clear Creek area has seventeen species of concern (species listed as endangered or threatened by the State, or recognized by the California Natural Diversity Data Base, the Bureau of Land Management, or others). Eight species of concern are plants: *Layia discoidea* (rayless layia), *Pentachaeta exilis* ssp. *aeolica* (slender pentachaeta), *Acanthomintha obovata* ssp. *obovata* (San Benito thornmint), *Calystegia collina* var. *venusta* (South Coast Range morning-glory), *Chorizanthe biloba* var. *immemora* (San Benito spineflower), *Fritillaria falcata* (talus fritillary), *F. viridea* (San Benito fritillary), and *Phacelia phacelioides* (Mt. Diablo phacelia). Nine species of concern are animals: *Rana boylei* (foothill yellow-legged frog), *Clemmys marmorata pallida* (southwestern pond turtle), *Thamnophis hammondi* (two-striped garter snake), *Myotis evotis* (long-eared myotis), *Myotis volans* (long-legged myotis), *Myotis yumanensis* (Yuma myotis), *Eumops perotis californicus* (greater western mastiff-bat), and *Amphispiza belli belli* (Bell's sage sparrow).

² Phytosociology (plant sociology), is the study of what plants occur together, originally with the intent of describing plant communities by comparing their floras.

All are potentially adversely affected by mechanized recreation, which — depending on its frequency, intensity, timing and duration — has been considered the principal threat to the San Benito evening-primrose (Taylor 1990, 1995). Potential effects of mechanized recreation include primary loss of habitat, sediment disturbance in aquatic habitats, nest disruption, disruption of normal behavior patterns, increased susceptibility to predation or extreme weather, habituation to humans and roost disturbance. In addition, the California Native Plant Society's Inventory (Skinner and Pavlik 1994) includes 11 additional rare, endangered, or vulnerable plants known to occur in the San Benito Mountain region.

F. LIFE HISTORY/ECOLOGY

The San Benito evening-primrose was confirmed to be autogamous (self-pollinating) through controlled experimentation (Taylor 1990). Germination in the field has been documented from early February to late March, with the bulk of the cohort germinating from late February to early March (Taylor 1990). Flowering occurs in mid spring and seed pods are mature by early summer. Flowers open in the early morning and are generally closed by mid-day. The relative productivity of plants and occurrences has been assessed through field measurements of numbers of capsules per plant (predominantly one) and numbers of seeds per capsule (90 to 100). The seeds are of two color phases (black-and-angular or blond-and-rounded) that differ in germination response. The black seeds germinate more readily and comprise more than 95 percent of the total seed production (Taylor 1990). Soil samples collected from suboccurrence 51200 (population 5) and suboccurrence 91100 (population 9), were analyzed for density of germinable seed. The samples yielded a range of 100 to 4,700 seeds per square meter³.

Population densities and numbers of San Benito evening-primrose plants varied greatly over several growing seasons. This variation appears to be largely caused by annual variation in rainfall, rather than by the amount of seed produced during the previous year (Taylor 1989).⁴

³ Soil samples were blocks of soil, 1 centimeter by 1 centimeter on the surface and 5 centimeters deep (0.4 in. by 0.4 in. by 2 in. deep).

⁴ Germination can be inhibited or triggered by factors such as light intensity, photoperiod, temperature, temperature fluctuations, moisture, physical abrasion of the seed coat, chemical influences on the seed coat and perturbation events such as landslides, flood, or fire. Furthermore, there is evidence that the conditions under which seeds are stored (buried) can induce dormancy in seeds that show no dormancy (continued...)

Long term seed storage in the soils is essential for the survival of the San Benito evening-primrose. The vulnerability of occurrences to extinction will be directly proportional to the depletion of seed reserves by years of chronic disturbance (Taylor 1989).

For a plant to reproduce successfully, its seeds must be dispersed to sites where they can germinate and establish seedlings. Places where such conditions are met are known as safe sites (Harper 1977). San Benito evening-primrose safe sites are presumably available in the immediate vicinity (within a few square centimeters) of the parent plants. Although the short stature of the plants when in fruit (5-10 centimeters [2-4 inches] tall) presumably makes for short-distance seed dispersal, a population can drift through appropriate habitat over a period of several years. Through a number of years, growing plants of the species are expected to appear on more of the available habitat than is observed during any single year. Support for the idea that the species has long-distance seed dispersal, at least over the long term, comes from the frequency of suboccurrences separated by perennial streams (six occurrences), occasional establishment of plants surrounded by "barriers" such as at suboccurrence 51100 (U.S. Bureau of Land Management 1997b), the distribution of occurrences over a large geographic area in a number of watersheds, and by the availability of non-gravity dispersal mechanisms such as wind (including dust devils hundreds of feet high), sheet runoff, and small vertebrates.

Seedling survivorship was documented for suboccurrences 51200, 51100 and 91100 (populations 5, 6, and 9, respectively) (Taylor 1990). Suboccurrence 51200 (population 5), the largest of the three, had 48 percent mortality whereas suboccurrence 51100 (population 6) had 73 percent mortality and suboccurrence 91100 (population 9) had 83 percent mortality. The majority of the mortalities were attributable to drought; less than a third of the mortalities resulted from predation from plant-eating (phytophagous) insects; and 10 percent of the mortalities resulted from early growing season frost-heaving of the soil, which damaged the roots (Taylor 1990).

(...continued)

when freshly collected (Silvertown 1987).

G. CONSERVATION MEASURES

The following efforts have been carried out and/or started to conserve the San Benito evening-primrose and its habitat. Efforts are listed in chronological order.

Efforts Currently in Place:

- The San Benito Mountain Natural Area was designated in 1968 to protect unique serpentine forests and associated plant communities.
- Pipe barriers and fences have been erected to protect populations, starting in the 1970's and continuing to the present.
- An implementation plan for off-road vehicle designations in the Clear Creek Recreation Area adopted by the Bureau, 1982.
- The Bureau started annual plant monitoring, 1983.
- San Benito evening-primrose was listed as a federally threatened plant by the Service, February 1985.
- Recreation staging areas with outhouses were built to encourage concentrated camping, 1985.
- Low water crossings constructed along Clear Creek to reduce sediment delivery, 1985.
- The Service rendered a Biological Opinion on management of the species, 1985.
- Clear Creek management plan and decision record adopted, 1986.
- A new Bureau administrative site was built to increase field presence and management efficiency, 1988.
- Life history study by Dean Taylor was funded by the Bureau, 1988-1995.
- Taylor attempted San Benito evening-primrose reintroductions, 1988.
- Hollister Resource Area applied to State Office of Bureau of Land Management for mineral withdrawal in the Clear Creek area. The application was denied by the State Director, 1988.
- Bureau hired a full-time, permanent botanist, 1990.
- Full-time, permanent law enforcement officer stationed at the Bureau's administrative site begins, 1993.
- The Bureau acquired 520 acres along lower Clear Creek up to and including its confluence with the San Benito River to protect riparian and San Benito evening-primrose habitat, 1990-1994. The acquisitions placed seven suboccurrences under Bureau management. Most of the length of this reach has been protected by fencing. No non-compliant OHV events have occurred on any of these suboccurrences since compliance monitoring began in October 1996.

- Watershed model developed by PTI, 1993.
- Road inventory conducted by Pacific Watershed Associates (1995) on 110 miles of most used routes with prescriptions to reduce road related erosion and sediment delivery.
- In 1995 the Bureau published a final Environmental Impact Statement (EIS) that evaluated management objectives for the next 15 years in the 30,000-acre Serpentine Area of Critical Environmental Concern (ACEC) that is also designated as the Hazardous Asbestos Area (HAA) within the 50,000-acre Clear Creek Management Area (CCMA). A proposed action was selected from the Clear Creek Final Environmental Impact Statement (U.S. Bureau of Land Management 1995), using information acquired from studies on asbestos-related health risks, rare plant research, and an analysis of erosion problems. It has five objectives: 1) reduce asbestos exposure and asbestos emissions while still providing opportunities for OHV use. Minimize dust emissions from main roads and ensure that Bureau employees meet all Occupational Safety and Health Administration requirements. Additionally, the Bureau proposes to expand an administrative site near the CCMA to accommodate heavy equipment storage and maintenance; 2) protect existing occurrences of the San Benito evening-primrose and attempt to expand its range into areas with moderate- to-high quality potential habitat for the species; 3) reduce erosion and sediment transport in all CCMA watersheds; 4) adjust the boundaries of the San Benito Mountain Natural Area to include a cross-section of the unique serpentine and adjacent ecotones found only within this area, using easily identifiable geographic landmarks as boundaries wherever possible; and 5) manage Clear Creek Management Area for dispersed OHV use and, based upon resource management criteria, establish open or closed areas as conditions and resources warrant. 1995.
- A "Biological evaluation of continued administrative use and proposed expansion of BLM administrative facilities in southern San Benito County, California" was developed by the Bureau in 1995. This document defines the final allowed footprint of disturbance for administrative use. It proposed small modifications, still to be completed, to the size of several staging and parking areas. Mitigation was also proposed. Monitoring to document occupancy of the Administrative Site by San Benito evening-primrose is continuing through 1998.
- A baseline inventory of potential habitat polygons was initiated to recommend protection measures, establish 60 repeatable photopoints, and create sketches of occupied polygons to assure repeatability of compliance monitoring, 1996.

- A crew was hired to build protective fences that had been recommended for potential habitat polygons and riparian zones, 1996-1998. Fences were also built and maintained on occupied terraces.
- Compliance monitoring started on a monthly basis from October to May and bimonthly from June to September, allowing timely reporting of problems to fence crew and law enforcement officer to quickly change non-compliant use patterns, 1996. The monitoring has documented a large reduction of non-compliant OHV use and intensity of disturbance as a result of protective measures.
- Bureau develops and implements a recurring road maintenance programmatic Environmental Analysis to avoid sensitive resources while improving road drainage and reducing sediment delivery, 1996.
- Increased signage has encouraged OHV use on well-maintained routes and destinations that are not near the sensitive resources.
- Starting in 1996, volunteer OHV enthusiasts greeted visitors at the mouth of Clear Creek on busy weekends to explain how compliance with protective closures was critical to maintaining an OHV recreational opportunity at Clear Creek.
- The Service rendered a Biological Opinion on management of Clear Creek and the Administrative Site, 1997. Data were analyzed related to protecting San Benito evening-primrose and its habitats. Topics of discussion included asbestos dust suppression, protection of San Benito evening-primrose, control of erosion and sediment, expansion of the San Benito Mountain Natural Area and redesignation to a Research Natural Area, management of off-highway vehicle recreation, administrative site use and development, monitoring (effectiveness and population), and criteria used to determine if complete closure to OHV use is necessary.
- Focused inventory of *Layia discoidea*, another plant of serpentine soils, started, 1997.
- Barrens inventoried in advance of open area designation, 1997

Efforts Currently Underway:

- Barren open areas are designated to minimize on-site and off-site impacts.
- Routes are designated to minimize impacts to sensitive resources and reduce erosion and sediment delivery.
- All terraces identified by Taylor (1990) as potential habitat are being included in the more inclusive potential habitat polygons (39 of 53 terraces have not yet been synonymized with the new nomenclature).
- Gates are planned to effect wet-season closures.

- Rerouting of trail around occurrence 131100 is planned to reduce impacts to terrace and adjacent stream.
- Staging areas are being replaced by facilities outside of the serpentine zone.
- Clear Creek County Road is being replaced.
- Hollister Field Office has been named a visitor fee collection pilot area. Visitor registration and fee collection is approved and being planned.
- Research is continuing on topics including determining genetic variation within and between occurrences, determining the longevity of seed in the soil, and development of techniques to counter encroachment of woody vegetation into openings dominated by grasses and herbs.

H. REASONS FOR LISTING AND CURRENT THREATS

Reasons for Listing:

The San Benito evening-primrose (*Camissonia benitensis*) was listed as a threatened species by the U.S. Fish and Wildlife Service on 12 February 1985 (50 FR 5755-5759). At the time of the listing nine occurrences were known, all in either the Clear Creek or San Carlos Creek drainages, and the total population was estimated to be less than 1000 individuals. The final rule stated: “(T)his action is being taken because a significant portion of the limited range of the species is subject to gravel mining and damage by off-road vehicle (ORV) use” (50 FR 5755). Other factors cited in the final rule that affected the species’ continued existence were the absence of appropriate regulatory authority to provide adequate protection for the species, the species’ moderate reproductive potential, the species’ ability to recover after disturbance is removed, and the meager information available on its life history requirements.

Historically, the Clear Creek area was the site of numerous mines and associated roads. It was also logged heavily, primarily in support of local mining. The effects of these historical uses on the current status and distribution of the species are not known.

Current Threats:

The threats currently facing the San Benito evening-primrose in the Clear Creek Area are noncompliant OHV use, sediment delivered onto habitat, erosion of habitat,

encroachment of woody chaparral into openings, gravel mining, and random environmental events.

Uncontrolled OHV use has been considered the biggest threat to *Camissonia benitensis* (U.S. Bureau of Land Management 1970, 1981, 1982, 1984, 1986, 1993, and 1995; Losos *et al.* 1993; Taylor 1990, 1991, 1993, and 1995). The Clear Creek area attracts OHV recreationists in large numbers because its serpentine areas offer open slopes (U.S. Bureau of Land Management 1995). These open slopes, when undisturbed, are protected from erosion by the silt-clay crust that forms on serpentine soils. When the crust is disturbed, mass wasting occurs (Kruckeberg 1984). OHV recreation caused disturbance of soil integrity, soil loss, compaction of soil, and destruction of plants. Over two-thirds of the terraces in Clear Creek Canyon have been heavily disturbed by recreation (camping, vehicle traffic and OHV use). As listed above, in "conservation measures," many miles of fence have been erected to protect habitats and riparian corridors, a law enforcement officer is assigned to the area, and other measures have been taken to protect the Clear Creek area while maintaining an OHV recreational opportunity. Still, some noncompliant use continues requiring continued monitoring, repair and replacement of barriers and signs, enforcement action, and occasional rerouting to avoid sensitive areas.

The average sediment yield for undisturbed soil is estimated at 3.2 tons per acre per year. The CCMA comprises 50,000 acres yielding a natural sediment loss of 96,000 tons per year. An estimated 38,000 cubic yards of sediment are lost at the mouth of Clear Creek each year (U.S. Bureau of Land Management 1995). Soil loss under recent management has been 160,000 tons per year, a 45 percent increase above natural levels (Ellis *in litt.* 1994). The proposed management alternative selected by the Bureau would attempt to reduce the sediment loss to 122,300 tons per year, 26 percent above natural levels (Ellis *in litt.* 1994).

Riparian habitats are subject to accelerated sediment deposition from wet-season use of the road system in the CCMA and the road maintenance made necessary by such use. Regrading causes direct sediment input. Recent changes in maintenance practices will reduce sedimentation to an unknown degree. Wet-season use of roads for recreation and resulting road maintenance are adverse influences on the habitats of at least three species of concern (foothill yellow-legged frog, southwestern pond turtle, and two-striped garter snake).

The Bureau's asbestos decontamination facility (laundry, showers and car wash/vacuum where Bureau employees are required to process themselves and equipment after exposure) and residence for the CCMA law enforcement officer were inadvertently

constructed on a San Benito evening-primrose population (population 19, also called the Section 8 population). Operation of the facility and residential complex causes, in addition to the direct loss of plants, impacts from modified hydrology and from prevention of the population from moving through suitable habitat. The proposed increase in facility development will further intensify these effects, the most serious being the long term confinement of a species that persists by migrating throughout its habitat.

The Bureau in cooperation with the U.S. Forest Service and the California Department of Parks and Recreation (CDPR) Off-Highway Motor Vehicle Recreation Division has developed and published guidelines for soil conservation for OHV recreation management (CDPR 1991). Part II of this recovery plan incorporates many of the standards established by the Bureau and others. The guidelines were required by State Public Resources Code for the management of OHV recreation areas that are State-managed or that received State funding for management. The guidelines recognize the significance of soil resource losses from OHV recreation and establish standards sufficient to allow restoration. The Bureau receives State funding for OHV management.

Woody plants have been encroaching on a number of the occurrences (Taylor 1990). Taylor (1990) speculated that seed of the San Benito evening-primrose is not likely to remain viable through an entire cycle of woody encroachment into occupied habitat. Whether woody encroachment, and the accompanying shading, would eliminate this species from an area depends on how long the seed bank remains viable and how long it takes for a stand-replacing fire to occur. While at least three fires have occurred within the CCMA starting in the 1950s, none has gone through occupied or potential habitat. Prescribed fire could potentially be employed to reverse encroachment of woody vegetation into terrace sites, but this appears not to be practicable because of the potential asbestos health hazard associated with the soils of the San Benito serpentine body. The asbestos hazard prevents participation in fires by the California Department of Forestry and Fire Protection and the Department of Corrections, which cooperatively manage prescribed fire with the Bureau (Bruce Delgado, Botanist, Bureau of Land Management, Hollister Field Office, pers. comm. 1994).

Randomly-occurring events such as prolonged drought and catastrophic erosion and sedimentation have a potential of unknown magnitude to affect this species' continued existence. Direct management actions to address these threats are probably impractical. The best defenses against random events are a healthy functioning hydrologic regime and widely dispersed San Benito evening-primrose occurrences and potential habitat, so that its survival does not depend on just a few occurrences. Ensuring that the plant is widely dispersed is

being accomplished by placing protective barriers around entire habitat polygons to enclose all moderate to high potential habitat. Erosion and sedimentation is prevented through providing better road drainage and route designations. Out of 33 routinely monitored suboccurrences, none experienced significant loss of habitat due to either erosion or sedimentation during the much above-average rainfall events of winter 1997/1998. Two suboccurrences had minor adjacent bank erosion (11100 and 291100), two had minor and localized sediment deposition (21400 and 291300), three had minor but visible evidence of surface sheet flow (111100, 131100 and 271100), and one had significant sediment deposition on an unoccupied portion of its potential habitat polygon (121100) (S. Fitton, pers. obs. 1998). Two suboccurrences (181100 and 291300) were thought to have been extirpated following the major runoff events of 1995. However, suboccurrence 291300 was found to be occupied and expanded in 1998. These two suboccurrences are unusual in being on flood plains rather than higher and safer terraces. Unfortunately, they may well be short-lived; they can, however, be naturally reestablished as was documented in 1998.

The degree of threat from randomly-occurring events is less than was perceived at the time of listing because the species is now known from 27 occurrences and 52 suboccurrences compared to 9 occurrences at the time of listing, and the species' distribution has been extended downstream along the San Benito River and into new watersheds (Lorenzo Vasquez Creek, Laguna Creek, White Creek, upper reaches of Clear Creek, Larious Creek, Picacho Meadow, San Benito River, and an unnamed tributary to the San Benito River downstream of the confluence with Lorenzo Vasquez). During 1998's inventory, 3 new occurrences with 8 suboccurrences were discovered and 6 new suboccurrences were discovered at existing occurrences.

The Bureau acquired the surface, but not the mineral rights, of 520 acres along the lower reaches of Clear Creek up to and including the confluence with the San Benito River. The acquisitions placed seven suboccurrences under Bureau management. While gravel mining in the area has ceased, the Bureau cannot provide absolute protection to the three suboccurrences within or adjacent to a historic mining operation because it does not own the mineral rights. Requests for entry onto Bureau-managed surface to extract gravel would result in Section 7 consultation with the Service.

Following the recommendations of the unpublished first draft recovery plan for the San Benito evening-primrose (U.S. Fish and Wildlife Service 1988), the Bureau funded a life history study. It focused on seven tasks: 1) demographic monitoring of occurrences, 2) population census, 3) germination and growth requirements, 4) breeding system and

pollination, 5) animal interactions, 6) competitive interactions, and 7) habitat requirements. The data have greatly enhanced the knowledge of the species and have been incorporated into this recovery plan.

Establishment of artificial occurrences has been attempted at four locations in the Clear Creek watershed (Figure 1). Seed was gathered from the largest known population (5) and cultivated in Aptos, Santa Cruz County, producing more than 100,000 seeds (Taylor 1991). Only 194 plants resulted from sowing 150,000 seeds. Population 1C had the majority of the success with 147 plants occurring from 60,000 seed, population 7 had 28 plants from 30,000 seed, population 16 had 16 plants from 30,000 seed, and population 17 had 3 plants from 30,000 seed (Taylor 1993). These results indicate a very low establishment rate for plants from broadcast-sown seed, so this technique is not adequate for establishing viable occurrences of the San Benito evening-primrose (Taylor 1993). Recent reviews of attempts to create self-sustaining occurrences of rare plants noted that most of those projects have not been successful (Fiedler 1991, Pavlik *et al.* 1993).

I. RECOVERY STRATEGY

The main purpose of this plan is to prevent further loss of the San Benito evening-primrose and associated species of concern (page 10). Recovery may take many decades and will depend on ecosystem-level protection. Recovery of the San Benito evening-primrose requires the protection and restoration of the habitat and ecosystem upon which the species depends. Although Taylor's (1990, 1991, 1993, and 1995) surveys doubled the number of known occurrences of this plant, they also showed that its habitat was severely degraded in many locations. Recent intensive surveys (BLM 1996, 1998) located still more previously-unknown occurrences and suboccurrences, expanding the known distribution of the San Benito evening-primrose into a second watershed. The 1996 survey recommended extensive fencing of potential habitat. From a biological perspective, Taylor's (1990, 1991, 1993, 1995) Bureau-contracted studies indicated that managing and protecting only the terrace sites presently occupied by San Benito evening-primrose populations would not assure recovery of the species. In 1996 the Bureau shifted its management focus from the protection of occupied habitat to the protection of potential habitat. Fencing and associated compliance monitoring are reducing the rate of habitat decline, protecting occurrences, and providing available habitat for recovery.

Protected areas must include potential habitat and allow for the long-term dispersal of the species within and between sites. Habitat restoration techniques must be developed and implemented. Ongoing watershed-level management for natural creek and terrace dynamics as outlined in the road erosion inventory and action plan for the CCMA (Pacific Watershed Associates 1995) is necessary for the San Benito evening-primrose's persistence and recovery. Planning and implementation of erosion control measures must continue at the watershed scale to reduce future destruction of habitat due to flooding and sediment deposition. This includes management actions such as route designation and the selection of high-use OHV recreational areas (Dynamac Corporation 1998). The goal for sediment loss must approach natural levels of erosion to prevent the continued loss of occupied and potential habitat for the species. The soils of the CCMA are extremely fragile. Management must prevent further damage to those soils.

Continued development and implementation of a highly-regulated OHV area similar to the State Vehicular Recreation Areas is recommended to protect sensitive resources at the ecosystem level and reduce erosion problems.

II. RECOVERY

A. OBJECTIVES AND CRITERIA

The immediate objective of this recovery plan is to prevent further loss of the San Benito evening-primrose, along with other associated species of concern, and to prevent the further deterioration of their habitats. After the decline of San Benito evening-primrose is halted, the plan's objective is to delist the species. The plan provides the criteria for reclassification and outlines the requisite actions for the accomplishment of each criterion.

The Clear Creek watershed is the principal area where the plant will be recovered, because this watershed contains 70 percent of the occurrences managed by the Bureau and about 75 percent of the individuals of the San Benito evening-primrose. The recovery criteria presented here represent the combined projections from the life history reports of Taylor (1995), comments from the Bureau, and information in the Service's files.

The minimum criteria for retaining San Benito evening-primrose in threatened status, rather than elevating it to endangered status are: 1) threats from habitat loss are minimized by the protection and restoration of presently-occupied and nearby appropriate habitat, 2) threats of decline and loss of occurrences due to small population size are minimized by the existence of at least 10 large populations of 10,000 or more individuals (comparable to the largest existing populations) in good rain years (85-115 percent average precipitation), 3) protection and stabilization of at least 20 smaller populations of 500 or more individuals, and 4) those occurrences are self sustaining for 10 years.

The Service will consider the species recovered when, in addition to the conditions needed to retain the plant in threatened status, 1) at least 15 or more large occurrences and at least 30 small occurrences have been protected and maintained, and 2) the threat of habitat destruction and degradation from mechanized recreation and mining has been removed. These criteria may be modified as justified by further research and new information.

B. NARRATIVE OUTLINE

1. Prevent additional degradation and loss of habitat for the San Benito evening-primrose and special status species

Nearly all occurrences of the San Benito evening-primrose and species of concern in the Clear Creek area (see page 11) are exposed to activities that threaten their continued existence. Reduction of the threats to the Clear Creek ecosystem is necessary to recover sensitive species and their habitats. Information on the distribution and critical aspects of the life histories of special status species should be obtained to assess suitability of sites for OHV activity. This information should be used to evaluate, and change as necessary, the existing management plan to ensure that the management plan provides for continued OHV recreation while ensuring the protection of sensitive resources. Areas should be opened to OHV use if the use is compatible with recovery of the San Benito evening-primrose.

It should be noted that the section 7 consultation process of the Federal Endangered Species Act is an essential mechanism for minimizing or eliminating adverse impacts to the San Benito evening-primrose from construction and other activities, and ensuring that the plant's recovery remains possible. Because section 7 consultations are an ongoing obligation of Federal agencies, they are not included as a task in this recovery plan.

11. Close all use areas that occur in proximity to the San Benito evening-primrose and special status species habitats.

Recreational users have come to expect widespread use of the Clear Creek area except the San Benito Mountain Natural Area. Therefore, closed areas should be publicized, explained, and clearly marked. Patrols of closed areas should be frequent to ensure compliance and minimize violations. Upper Clear Creek has suitable habitat for the San Benito evening-primrose and *Layia discoidea* (rayless layia). It closure must continue to be actively enforced. The vehicle trail through suboccurrence 51100 (population 6) should be closed or rerouted.

111. Design and implement a plan for signing open and closed areas by 1998.

OHV recreationists need to know where the closed areas are. Only the main roads should remain open until a determination has been made that

OHV use in other areas would not adversely affect the San Benito evening-primrose.

112. Maintain signs.

As long as OHV recreation is permitted, signs should be inspected and maintained weekly to minimize habitat degradation. Bureau staff should inspect all signs for damage or removal. Procedures should be established to expedite maintenance and replacement of damaged signs.

113. Close all terrace sites to camping and OHV use.

Stream terrace sites comprise habitat for the San Benito evening-primrose and should be closed to camping and staging to prevent further impacts. The closures are needed to reduce the severity of adverse impacts to the habitats of the San Benito evening-primrose and other sensitive species. Where the roads remain open, closure of camping/staging areas should be accompanied by interim signage and construction of vehicle barriers at the closed areas. Staging areas 1 and 5 should have highest priority for closure because the San Benito evening-primrose recently colonized those sites.

114. Construct vehicle barriers around all existing San Benito evening-primrose habitat on Bureau lands, including damaged terraces adjacent to open roads.

San Benito evening-primrose habitat occurs along the road corridor in Clear Creek. Because these roads will almost certainly remain open to OHV use, these habitats will continue to be exposed to damage by OHV activities. Recovery of the species will require the continued protection of its occupied habitats and potential habitat polygons by fencing or other types of vehicle barriers. As initiated in 1996, the fencing of potential habitat instead of fencing only the perimeter of occupied habitat must continue. Fenced habitat must be extensive enough to allow occurrences of San Benito evening-primrose to migrate through all usable areas adjacent to the current location of the population. This will optimize the persistence of the species.

New fencing and barriers will be needed for the habitat of recently discovered occurrences and any other moderate-to-high quality potential habitat areas of the San Benito evening-primrose discovered in the future. Unoccupied sites that can serve for recovery actions should be protected to prevent further degradation, receiving second priority for protection after occupied sites.

Degraded sites should be evaluated for severity of damage to rank the immediacy of protection needed. Sites that show potential for restoration should be protected from additional degradation.

115. Actively manage OHV closure zones.

Continue to develop and implement law enforcement procedures that ensure compliance.

12. Develop and implement an OHV plan to open areas that will not impair recovery actions.

Designation of open areas for OHV recreation use should protect the habitats of the San Benito evening-primrose and other species of concern as discussed in Section E (page 8). Standard practices for resource management in OHV areas on arid lands in the State of California have been developed cooperatively with the Bureau. The standards specify that areas will be closed when rehabilitation is not feasible.

121. Identify use areas that are compatible with the protection of the habitats of the San Benito evening-primrose and special status species and sensitive habitats before designation for OHV recreational use.

Review the life history requirements of the listed and special status species to determine habitat needs.

1211. Determine life history and habitat requirements for special status species.

Assemble information on the life history strategies, community associations, and habitat requirements of special status species and/or similar closely related species so informed guesses can be made about their habitat requirements, pollinators, eating habits (for animals), etc. Then, using this information, conduct surveys to establish where the species are, and what the animals are doing. Determination of factors such as pollination, reproduction, seed production, age to maturity, and longevity are needed to determine how recovery programs will be conducted. This information will also be important in monitoring occurrences and determining the viability of protected occurrences.

1212. Conduct surveys for special status species.

Using the information gained in task 1211, surveys can be conducted at the best time of the year to determine presence and habitat suitability for special status species.

1213. Develop standards for erosion, vegetation, and sensitive species impacts and implement management actions to achieve those standards.

The amount of sediment lost from the watershed should not greatly exceed natural levels. It is suggested that 10 percent above natural sediment loss is acceptable. Currently, sediment loss is more than 45 percent above natural amounts. The Bureau, Resource Conservation District (U.S. Dept. of Agriculture Natural Resources Conservation Service), Central Coast and Central Valley Water Quality Control Boards, the Environmental Protection Agency (EPA), and the Service should cooperate in establishing standards.

122. Develop and implement a plan.

Areas should be reopened to OHV activities after managers designate recreational use areas that do not threaten the San Benito evening-primrose or the species of special concern. The recreational use plan must rely on the results of task 121. When areas or trails cannot be maintained to standards (task 1213) for long-term use, they should be closed and repaired. Executive Orders 11644 and 11989 may be used to further justify this task.

13. Monitor effectiveness of habitat management.

Management actions to provide for recovery must be evaluated regularly to be able to take timely corrective actions if there is resource loss and/or damage. The compliance monitoring program initiated in 1996 should continue. (Note: Task 13 monitors the effectiveness of the larger habitat issue while task 2 is specific to individual occurrences).

131. Collect aerial and ground photography.

The acquisition and interpretation of vertical aerial photography on regular flight paths is an essential tool to be employed in monitoring the success of management actions in rugged terrains. Standard photo points should be established on the ground. Additionally, photographs should establish a record of use several times during peak use seasons.

132. Compare photography to determine user compliance.

Imagery should be analyzed annually. Qualified individuals (backgrounds in geography, air photo interpretation, or biology) will assess user compliance with mapped and signed closed areas designated to protect sensitive resources.

133. Monitor San Benito evening-primrose and special status species occurrences.

Develop and implement a data-collecting program regarding the status of select species of concern and other sensitive resources that relate to the protection of the San Benito evening-primrose. Information collected should include proximity of threats, sizes of occurrences and their distribution, associated species, condition of sites, and other information determined necessary to evaluate the status of the species. Data should be collected and analyzed by trained and qualified biologists.

14. If compliance with route and hillclimb closure is not achieved, close access routes to those areas until an effective management program can be developed and implemented.

If the habitats of San Benito evening-primrose continue to be degraded despite the measures outlined above, closure of the principal entrances to the Clear Creek area or affected sites in the area would be appropriate until some means (e.g., a user fee structure) is found to finance active management of OHV areas. Such a program could resemble the Bureau's protection of sensitive resources through an aggressive enforcement program in the Eureka Valley area. User fees have been successfully employed by the State of California to manage State Vehicular Recreation Areas, and a similar approach is recommended for Clear Creek.

2. Develop and implement a monitoring and life history management plan for the San Benito evening-primrose.

Monitor habitat conditions to evaluate trends in population status for the San Benito evening-primrose. Additional information is needed regarding the life history attributes of the species to provide for a more complete understanding of recovery needs.

21. Monitor occurrences.

To determine the success of population site management and the species' status, the Bureau should continue its existing annual monitoring program, including

any newly discovered colonies. Additional monitoring of woody vegetation dynamics should be initiated to understand the degree of threat due to woody plants encroaching on occurrences. The use of standardized photo point monitoring techniques should continue..

211. Conduct annual population surveys.

The continuation of spring surveys by qualified biologists based on the methods established by Taylor (1990) and Bureau biologists (U.S. Bureau of Land Management 1997a, 1997b, and 1998) is necessary to establish a long-term data base to comprehend the population trends for this species. An understanding of local population extirpation, establishment, and spatial and temporal linkages among occurrences is essential to appropriately manage this narrow endemic. The geographic information system and relational databases linking spatial and attribute data developed by the Bureau in 1996 should be maintained and expanded as new occurrences are discovered (U.S. Bureau of Land Management 1997a). Because occurrences tend to move about, the record of the population center established in this database for most occurrences should be maintained and updated annually. This information regarding shifts in spatial distribution at each occurrence should be evaluated annually to determine if fence lines require adjustment.

212. Monitor woody vegetation on terrace sites where habitat displacement is suspected.

Establish permanent plots using standard vegetation measurement techniques and monitor sites for changes in canopy cover of woody species annually for at least ten years to determine rate of habitat displacement (Taylor 1990).

213. Establish accurate photo monitoring points.

The standardized system of establishing, permanently marking, and twice yearly monitoring of photo points that was initiated by the Bureau in 1996 should continue (U.S. Bureau of Land Management 1997a). The system should be applied to all newly discovered occurrences. The standardized

system is designed to prevent misinterpretation of information through scale distortion and requires that camera and lens information are recorded as well as tripod height, position, level and photo direction to ensure replication and registration of photography over long periods.

Photographs should be taken at the same time of year and hour to ensure comparable lighting between photographs. (Note: this task is at the scale of occurrences and sites. Task 13 is on the landscape scale).

214. Assess data.

Reports synthesizing and analyzing these data should be prepared annually.

22. Conduct research on life history factors to provide for additional recovery actions.

Life history attributes are needed to evaluate recovery needs for the species.

221. Continue seed bank research.

Because the evening-primrose is an annual, the persistence of any given population depends on its seed production, seed germinability, and extent of a seed bank in the soil. Research and/or literature searches should be conducted to understand the mechanisms that inhibit and trigger germination. Factors such as light intensity, photoperiod, temperature, temperature fluctuations, moisture, physical abrasion of the seed coat, chemical influences on the seed coat, and perturbation events such as landslides/mass movements of soils (a possible dispersal mechanism), flood, or fire should be analyzed. The influence of fire on seed germination is unknown, so small localized experimental fires may prove to be of great interest. See task 224 for fire research in general.

222. Continue population introduction research.

The number of populations may currently be too few for recovery of the species and the potential role of population augmentation and its benefit to the species should be carefully evaluated. The attempts at introduction to

date have not achieved successful results (Taylor 1993). Suitable unoccupied habitat should be located for additional experimentation. An applied research program, if introduction are determined to be of benefit, should be conducted and include the investigation of different introduction and habitat management techniques..

223. Conduct soils management research.

Soil development rates are probably measured in increments of decades, and where soils are intact, they need to be protected. Experimentation on disturbed sites to assist in restoring a soil profile is needed.

224. Conduct fire research.

Fire effects are unknown and deserve careful research design to understand the potential benefits and disadvantages of localized prescribed fire for long term management success for the San Benito evening-primrose. A research plan to address this question should be developed and studies initiated. While the asbestos contamination problem makes large-scale use of prescribed fire difficult if not impossible, localized prescribed fire could be used to reduce encroaching woody vegetation on the terraces.

23. Search for new occurrences.

The recent discovery of the San Benito evening-primrose on serpentine alluvial outwash has added a new search criterion that has not been fully explored. Most of this type of habitat is on private lands and may be searched only with landowner permission.

24. Revise management based on monitoring and research results.

Based on research findings, management actions should be modified as necessary to provide for the recovery of occurrences and habitats.

3. Ensure protection of the San Benito evening-primrose on non-Bureau lands by establishing private land owner contacts.

Protection of the four known occurrences on private lands and any ones newly discovered in the future is important for the continued persistence of this species. The Bureau and the Service should contact private landowners to promote their voluntary assistance in preventing the inadvertent destruction of occurrences. Landowners should also be informed of the conservation needs of the San Benito evening-primrose and its ecosystem. Should additional occurrences be discovered on private lands, owners should be contacted and informed as soon as possible.

31. Develop informational materials for private lands.

Information developed for task 5 about the distinctive biology and ecology of the San Benito mountain region can be used to provide the basis for interpreting the situation to the land owners. Occurrences 111000 and 181100 (populations 11 and 18), suboccurrence 221100 (population 22), and population 24 are documented as private in Taylor's 1990, 1993, and 1995 reports to the Bureau. A standard informational presentation needs to be developed to inform the land owners of the habitat requirements of the San Benito evening-primrose. This will help prevent additional damage or loss of occurrences. If subsequent surveys reveal additional occurrences on private lands, educational materials should be presented to those land owners. Information about the Endangered Species Act and its intent should be developed to help conserve the plant and its habitat and to reduce potential misunderstanding and conflict.

32. Determine landowner short-term and long-term land use goals and their effects on the San Benito evening-primrose.

Develop and implement management plans that are beneficial to the species and acceptable to landowners. Because the San Benito evening-primrose occurrences are small and habitat is extremely limited, landowners probably can avoid incompatible land uses in those areas. Incentives to private landowners should be identified where possible. Plans should include prescriptions for grazing management, management of woody species, provisions to avoid certain land use practices, and monitoring.

321. Identify threats on private lands.

Survey private land, with landowner permission, to evaluate land use practice and potential threats to extant occurrences.

322. Develop and implement management plans for occurrences on private lands.

Work with land owners to identify alternative and compatible activities to avoid adverse impacts and, where possible, protect extant occurrences. Develop management plans that incorporate essential actions to protect the habitat and the species. Work with land owners to ensure plans are being implemented.

4. Develop and implement a management program for occurrence 191000 (Bureau decontamination facility).

Protecting occurrence 191000 (population 19, also known as the Section 8 population) will require development of a management plan to ensure that no further degradation occurs because of Bureau or employee actions. Facility management should include siting further development to avoid potential and occupied habitat, weed management guidelines that address the San Benito's evening-primrose annual cycle, survey of the surrounding area with habitat acquisition needs identified if new suboccurrences are discovered, and development of programs and materials (posters, brochures) to educate operational staff of the importance of this threatened species and of employee/agency responsibilities under the Federal Endangered Species Act.

5. Develop and implement a public education and awareness program for the preservation of the San Benito evening-primrose and its habitat.

Given that recreational enthusiasts, especially within Clear Creek Canyon, pose the most significant threat to the San Benito evening-primrose, a public education and awareness program likely will prove beneficial to the species' long-term survival. Such an effort must not focus entirely on the threatened plant, but also on the unique plant community, geology, and other rare species.

51. Provide public interpretation by trained staff.

Bureau personnel in this position should be knowledgeable about the unique serpentine ecosystem. Bureau personnel from the Hollister Field Office should regularly patrol the canyon (much of the recreational use, especially camping, in the Clear Creek area is concentrated within the canyon); the Bureau has the opportunity to make many individual contacts with the public (especially OHV enthusiasts) throughout the year. When such opportunities arise, the Bureau should present non-technical discussions on the need to protect the San Benito evening-primrose and its habitat (including the enclosures erected by the agency) along with the unique plant community, geology, and other rare and sensitive taxa found in the general area. Such a personal touch not only will lead to a better understanding of the uniqueness of the Clear Creek area, but likely will lead to greater compliance with the law. In addition, the Bureau has the opportunity to provide evening programs where slide shows and other audio-visual programs can present similar information to canyon visitors.

52. Encourage interpretive tours of the Clear Creek area.

User groups, especially four-wheel drive clubs, can provide effective programs about the need to protect sensitive habitats for their members. Environmental groups, like the California Native Plant Society and Sierra Club, can conduct interpretive tours and walks. In addition, local primary and secondary schools will likely conduct field trips to the general area (e.g., Pinnacles National Monument). Given that greater public awareness probably will lead to reduced anthropogenic effects on the San Benito evening-primrose, the Service, Bureau, and other agencies should encourage interpretive tours by the above groups of the Clear Creek area. Such tours should touch upon the need to protect the San Benito evening-primrose and its habitat (including the enclosures fenced by the Bureau) along with the unique plant community, geology, and other rare and sensitive taxa found in the general area.

Interpretive programs and their development must take into account the potential health risk from asbestos exposure.

53. Erect and maintain interpretive and informational signs near population sites.

Because most canyon visitors likely will neither participate in audio-visual programs and interpretive tours nor encounter Bureau staff, signs should be erected and maintained near population sites discussing the sensitive nature of the habitat within the enclosures for the San Benito evening-primrose and other rare plants, and other relevant natural history facts.

54. Work with OHV user groups to conserve Clear Creek Management Area and other habitat.

OHV enthusiasts can be asked to mend fences. Their expertise may also be helpful at developing appropriate signs, user fee systems, and means to make closures work. Programs at other publicly-owned areas with extensive off-highway recreation may provide useful ideas.

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IV. IMPLEMENTATION SCHEDULE

The table that follows is a summary of scheduled actions and costs for the San Benito Evening-primrose Recovery Plan. It is a guide to meet the objectives of this plan, as elaborated upon in Part II, Narrative. This table indicates the tasks to meet the objectives, the agencies that are responsible to perform these tasks, and finally, the estimated costs to accomplish these tasks. Implementing Part III is the action of the recovery plan, that when accomplished, will bring about the recovery objectives of this threatened species and protect its habitat.

Priorities in column one of the following implementation schedule are assigned as follows:

Priority 1: An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2: An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3: All other actions necessary to meet recovery plan objectives.

Abbreviations: BLM — U.S. Department of the Interior, Bureau of Land Management
FWS — U.S. Department of the Interior, Fish and Wildlife Service

Implementation Schedule for San Benito Evening-primrose Recovery Plan

Priority	Task No.	Task Description	Duration (years)	Responsible parties	Costs, thousands of dollars, by fiscal year					
					Total	1998	1999	2000	2001	2002
need 1: prevent additional deterioration and loss of habitat										
1	111	Plan for signing open and closed areas for OHV use	1	BLM	25	25				
1	112	Maintain signs	5	BLM	30	20	5	5	5	5
1	113	Close terrace sites to camping	1	BLM	25	25				
1	114	Establish barriers at San Benito evening-primrose habitat	2	BLM	20	10	10			
1	115	Manage closure zones	5	BLM	50	10	10	10	10	10
1	1211	Determine life history requirement for sensitive species	5	BLM	140	50	50	30	5	5
1	1212	Conduct habitat studies identified in task 1211	2	BLM	75	5	10	20	20	20
1	1213	Develop and implement standards for open use	2	BLM	7	5	2			
				FWS	2	1	1			
1	122	Develop and implement OHV management plan		BLM	25	5	5	5	5	5
			1	FWS	5	1	1	1	1	1

Task Priority No.	Task Description	Duration (years)	Responsible parties	Costs, thousands of dollars, by fiscal year						
				Total	1998	1999	2000	2001	2002	2002
1	132 Monitor use areas	5	BLM	50	10	10	10	10	10	10
1	133 Monitor listed and candidate species occurrences	5	BLM	5	1	1	1	1	1	1
1	14 Close areas that do not meet standards	5	BLM	100	20	20	20	20	20	20
Need 1 totals				634	193	140	117	92	92	92
Need 2: obtain information to identify management actions needed to recover the species										
2	211 Conduct annual population surveys	5	BLM	25	5	5	5	5	5	5
2	212 Monitor woody vegetation	5	BLM	5	1	1	1	1	1	1
2	213 Establish photo monitoring point	5	BLM	10	2	2	2	2	2	2
2	214 Assess data	5	BLM	10	2	2	2	2	2	2
2	221 Continue seed bank research	5	BLM	15	3	3	3	3	3	3
2	222 Continue introduction research	5	BLM	25	5	5	5	5	5	5
2	223 Conduct soils research	5	BLM	15	3	3	3	3	3	3
2	224 Conduct fire research	5	BLM	15	3	3	3	3	3	3
2	23 Search for additional occurrences	5	BLM	25	5	5	5	5	5	5

Task Priority No.	Task Description	Duration (years)	Responsible parties	Costs, thousands of dollars, by fiscal year					
				Total	1998	1999	2000	2001	2002
2	24	Revise management based on monitoring and research results	ongoing BLM						
Need 2 totals				145	29	29	29	29	29
Need 3: Non-Federal lands protection									
3	31	Inform private landowners	5 BLM	5	1	1	1	1	1
3	321	Identify threats on private lands	5 BLM	5	1	1	1	1	1
3	322	Cooperate with private lands	5 BLM	7	2	2	1	1	1
Need 3 totals				17	4	4	3	3	3
Need 4: Eliminate impacts at population 19									
3	4	Eliminate impacts at population 19	5 BLM	9	5	1	1	1	1
Need 4 totals				5	1	1	1	1	1
Need 5: Develop public information program									
3	51	Develop public interpretation	5 BLM	25	5	5	5	5	5
3	52	Encourage interpretive tours	5 BLM	10	2	2	2	2	2

Task Priority No.	Task Description	Duration (years)	Responsible parties	Costs, thousands of dollars, by fiscal year					
				Total	1998	1999	2000	2001	2002
3	53	Establish interpretive signs	5 BLM	13	2	2	2	2	2
3	54	Work with OHV user groups	5 BLM	20	8	3	3	3	3
Need 5 totals				48	17	12	12	12	12
TOTAL COSTS				864	243	185	161	136	136